

CLAIMS

What is claimed is:

1. A network device, comprising:
 - a media access control (MAC) device that transmits a first data stream at a first data rate that includes symbols having M bits;
 - a translator that converts said first data stream to a second data stream at a second data rate, wherein said translator includes:
 - a data appender that appends N bits to said symbols in said first data stream to generate second symbols having M+N bits; and
 - a data duplicator that duplicates said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and $\left(1 + \frac{N}{M}\right) \cdot X$.
2. The network device of claim 1 further comprising a first physical coding sublayer (PCS) device that communicates with said translator and that codes said second data stream received from said translator to produce a third data stream at a third data rate.
3. The network device of claim 2 further comprising a first serializer/deserializer (SERDES) that receives said third data stream from said first PCS device.

4. The network device of claim 1 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

5. The network device of claim 1 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

6. The network device of claim 3 further comprising:
a second SERDES that communicates with said first SERDES; and
a second PCS device that communicates with said second SERDES, that decodes said third data stream at said third data rate and that outputs said second data stream at said second data rate.

7. The network device of claim 6 further comprising a data sampler that selects one of X data symbols that are received from said second PCS, wherein said one of said X data symbols include $(M+N)$ bits.

8. The network device of claim 7 further comprising a data remover that removes N of said $(M+N)$ bits and that outputs symbols with said M bits at said first data rate.

9. The network device of claim 8 further comprising a physical layer (PHY) device that receives said M bits at said first data rate.

10. The network device of claim 9 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

11. The network device of claim 9 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

12. The network device of claim 9 wherein said PHY device performs mode auto detection and switches between a first serial gigabit interface mode and a second serial gigabit interface mode.

13. The network device of claim 6 wherein said first PCS device performs 8/10 bit encoding and said second PCS device performs 8/10 bit decoding.

14. The network device of claim 1 wherein said MAC device is implemented in one of a switch and a router.

15. A network device, comprising:

- a physical layer (PHY) device that transmits a first data stream at a first data rate that includes symbols having M bits;
- a translator that converts said first data stream to a second data stream at a second data rate, wherein said translator includes:
 - a data appender that appends N bits to said symbols in said first data stream to generate second symbols having M+N bits; and
 - a data duplicator that duplicates said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and $\left(1 + \frac{N}{M}\right)X$.

16. The network device of claim 15 further comprising a first physical coding sublayer (PCS) device that communicates with said translator and that codes said second data stream received from said translator to produce a third data stream at a third data rate.

17. The network device of claim 16 further comprising a first serializer/deserializer (SERDES) that receives said third data stream from said first PCS device.

18. The network device of claim 15 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

19. The network device of claim 15 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

20. The network device of claim 17 further comprising:
a second SERDES that communicates with said first SERDES; and
a second PCS device that communicates with said second SERDES, that decodes said third data stream at said third data rate and that outputs said second data stream at said second data rate.

21. The network device of claim 20 further comprising a data sampler that selects one of X data symbols that are received from said second PCS, wherein said one of said X data symbols includes $(M+N)$ bits.

22. The network device of claim 21 further comprising a data remover that removes N of said $(M+N)$ bits and that outputs symbols with said M bits at said first data rate.

23. The network device of claim 22 further comprising a medium access control (MAC) device that receives said M bits at said first data rate.

24. The network device of claim 23 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

25. The network device of claim 23 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

26. The network device of claim 15 wherein said PHY device performs mode auto detection and switches between a first serial gigabit interface mode and a second serial gigabit interface mode.

27. The network device of claim 20 wherein said first PCS device performs 8/10 bit encoding and said second PCS device performs 8/10 bit decoding.

28. The network device of claim 15 wherein said PHY device is implemented in one of a switch and a router.

29. A network device that operates in first and second serial gigabit interface modes involving data speed translation, comprising:

a medium access control (MAC) device that transmits idle order sets; and

a physical layer (PHY) device that receives said idle order sets and that switches from the first serial gigabit interface mode to the second serial gigabit interface mode if a first predetermined number of consecutive idle order sets are equal to a first idle order set.

30. The network device of claim 29 wherein said PHY device turns off autonegotiation associated with the first serial gigabit interface mode when in the second serial gigabit interface mode.

31. The network device of claim 29 wherein said PHY device begins sending said first idle order set after transitioning to the second serial gigabit interface mode.

32. The network device of claim 29 wherein when said PHY device receives a second predetermined number of consecutive idle order sets that are equal to a second idle order set, said PHY device transitions to the first serial gigabit interface mode.

33. The network device of claim 32 wherein said PHY device forces a restart of autonegotiation in the first serial gigabit interface mode after transitioning to the first serial gigabit interface mode.

34. The network device of claim 29 wherein said MAC device and said PHY device are connected by first and second serializer/deserializers (SERDES).

35. A network device, comprising:

a data translator that receives a first data stream at a first data rate and that includes:

a data sampler that selects one of X data symbols that are received, wherein said one of said X data symbols includes $(M+N)$ bits, and that outputs a second data stream at a second data rate; and

a data remover that removes N of said $(M+N)$ bits and that outputs a third data stream including symbols with said M bits at a third data rate; and

a physical layer device that receives said third data stream.

36. The network device of claim 35 further comprising a first physical coding sublayer (PCS) device that communicates with said translator and that decodes a fourth data stream at a fourth data rate to produce said first data stream.

37. The network device of claim 36 further comprising a first serializer/deserializer (SERDES) that outputs said fourth data stream to said PCS device.

38. The network device of claim 37 further comprising:

- a media access control (MAC) device that generates a fifth data stream;
- a second data translator that communicates with said MAC device and that converts said fifth data stream that is output by said MAC device to a sixth data stream at a higher data rate;
- a second PCS device that codes said sixth data stream into said fourth data stream; and
- a second SERDES that serially communicates said fourth data stream to said first SERDES.

39. The network device of claim 38 wherein said first PCS device performs 8/10 bit decoding and said second PCS device performs 8/10 bit encoding.

40. A network device, comprising:

a data translator that receives a first data stream at a first data rate and that includes:

a data sampler that selects one of X data symbols that are received, wherein said one of said X data symbols includes $(M+N)$ bits, and that outputs a second data stream at a second data rate; and

a data remover that removes N of said $(M+N)$ bits and that outputs a third data stream including symbols with said M bits at a third data rate; and

a media access control device that receives said third data stream.

41. The network device of claim 40 further comprising a first physical coding sublayer (PCS) device that communicates with said translator and that decodes a fourth data stream at a fourth data rate to produce said first data stream.

42. The network device of claim 41 further comprising a first serializer/deserializer (SERDES) that outputs said fourth data stream to said PCS device.

43. The network device of claim 42 further comprising:

- a physical layer (PHY) device that generates a fifth data stream;
- a second data translator that communicates with said PHY device and that converts said fifth data stream that is output by said PHY device to a sixth data stream at a higher data rate;
- a second PCS device that codes said sixth data stream into said fourth data stream; and
- a second SERDES that serially communicates said fourth data stream to said first SERDES.

44. The network device of claim 43 wherein said first PCS device performs 8/10 bit decoding and said second PCS device performs 8/10 bit encoding.

45. A network device, comprising:

media access control (MAC) means for transmitting a first data stream at a first data rate that includes symbols having M bits;

translating means for converting said first data stream to a second data stream at a second data rate, wherein said translating means includes:

data appending means for appending N bits to said symbols in said first data stream to generate second symbols having M+N bits; and

data duplicating means for duplicating said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and

$$\left(1 + \frac{N}{M}\right) \cdot X.$$

46. The network device of claim 45 further comprising first physical coding sublayer (PCS) means that communicates with said translating means for coding said second data stream received from said translating means to produce a third data stream at a third data rate.

47. The network device of claim 46 further comprising first serializer/deserializer (SERDES) means for receiving third data stream from said first PCS means and for serially transmitting said third data stream.

48. The network device of claim 45 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

49. The network device of claim 45 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

50. The network device of claim 47 further comprising:
second SERDES means for serially transmitting and receiving data and for communicating with said first SERDES means; and
second PCS means that communicates with said second SERDES for decoding said third data stream at said third data rate and for outputting said second data stream at said second data rate.

51. The network device of claim 50 further comprising data sampling means for selecting one of X data symbols that are received from said second PCS, wherein said one of said X data symbols include $(M+N)$ bits.

52. The network device of claim 51 further comprising data removing means for removing N of said $(M+N)$ bits and for outputting symbols with said M bits at said first data rate.

53. The network device of claim 52 further comprising physical layer (PHY) means for receiving said M bits at said first data rate.

54. The network device of claim 53 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

55. The network device of claim 53 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

56. The network device of claim 53 wherein said PHY means performs mode auto detection and switches between a first serial gigabit interface mode and a second serial gigabit interface mode.

57. The network device of claim 50 wherein said first PCS means performs 8/10 bit encoding and said second PCS means performs 8/10 bit decoding.

58. The network device of claim 45 wherein said MAC means is implemented in one of a switch and a router.

59. A network device, comprising:

physical layer (PHY) means for transmitting a first data stream at a first data rate that includes symbols having M bits;

translating means for converting said first data stream to a second data stream at a second data rate, wherein said translating means includes:

data appending means for appending N bits to said symbols in said first data stream to generate second symbols having M+N bits; and

data duplicating means for duplicating said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and $\left(1 + \frac{N}{M}\right)X$.

60. The network device of claim 59 further comprising first physical coding sublayer (PCS) means that communicates with said translating means for coding said second data stream received from said translating means to produce a third data stream at a third data rate.

61. The network device of claim 60 further comprising first serializer/deserializer (SERDES) means for receiving said third data stream from said first PCS means and for serially transmitting said third data stream.

62. The network device of claim 59 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

63. The network device of claim 59 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

64. The network device of claim 61 further comprising:
second SERDES for serially transmitting and receiving data and for communicating with said first SERDES; and
second PCS means that communicates with said second SERDES, for decoding said third data stream at said third data rate and for outputting said second data stream at said second data rate.

65. The network device of claim 64 further comprising data sampling means for selecting one of X data symbols that are received from said second PCS, wherein said one of said X data symbols includes $(M+N)$ bits.

66. The network device of claim 65 further comprising data removing means for removing N of said $(M+N)$ bits and for outputting symbols with said M bits at said first data rate.

67. The network device of claim 66 further comprising medium access control (MAC) means for receiving said M bits at said first data rate.

68. The network device of claim 67 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

69. The network device of claim 67 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

70. The network device of claim 59 wherein said PHY means performs mode auto detection and switches between a first serial gigabit interface mode and a second serial gigabit interface mode.

71. The network device of claim 64 wherein said first PCS means performs 8/10 bit encoding and said second PCS means performs 8/10 bit decoding.

72. The network device of claim 59 wherein said PHY means is implemented in one of a switch and a router.

73. A network device that operates in first and second serial gigabit interface modes involving data speed translation, comprising:

medium access control (MAC) means for transmitting idle order sets; and

physical layer (PHY) means for receiving said idle order sets and for switching from the first serial gigabit interface mode to the second serial gigabit interface mode if a first predetermined number of consecutive idle order sets are equal to a first idle order set.

74. The network device of claim 73 wherein said PHY means turns off autonegotiation associated with the first serial gigabit interface mode when in the second serial gigabit interface mode.

75. The network device of claim 73 wherein said PHY means begins sending said first idle order set after transitioning to the second serial gigabit interface mode.

76. The network device of claim 73 wherein when said PHY means receives a second predetermined number of consecutive idle order sets that are equal to a second idle order set, said PHY means transitions to the first serial gigabit interface mode.

77. The network device of claim 76 wherein said PHY means forces a restart of autonegotiation in the first serial gigabit interface mode after transitioning to the first serial gigabit interface mode.

78. The network device of claim 76 wherein said MAC means and said PHY means are connected by first and second serializer/deserializers (SERDES) means for serially communicating data.

79. A network device, comprising:

data translating means for receiving a first data stream at a first data rate and that includes:

data sampling means for selecting one of X data symbols that are received, wherein said one of said X data symbols includes $(M+N)$ bits, and for outputting a second data stream at a second data rate; and

data removing means for removing N of said $(M+N)$ bits and for outputting a third data stream including symbols with said M bits at a third data rate; and

physical layer means for receiving said third data stream.

80. The network device of claim 79 further comprising first physical coding sublayer (PCS) means for communicates with said translating means for decoding a fourth data stream to produce said first data stream.

81. The network device of claim 80 further comprising first serializer/deserializer (SERDES) means for serially communicating data and for outputting said fourth data stream to said PCS means.

82. The network device of claim 81 further comprising:

media access control (MAC) means for generating a fifth data stream;

second data translating means that communicates with said MAC means for converting said fifth data stream that is output by said MAC means to a sixth data stream at a higher data rate;

second PCS means for coding said sixth data stream into said fourth data stream; and

second SERDES for serially communicating said fourth data stream to said first SERDES.

83. The network device of claim 82 wherein said first PCS means performs 8/10 bit decoding and said second PCS means performs 8/10 bit encoding.

84. A network device, comprising:

data translating means for receiving a first data stream at a first data rate and that includes:

data sampling means for selecting one of X data symbols that are received, wherein said one of said X data symbols includes (M+N) bits, and for outputting a second data stream at a second data rate; and

data removing means for removing N of said (M+N) bits and for outputting a third data stream including symbols with said M bits at a third data rate; and

media access control means for receiving said third data stream.

85. The network device of claim 84 further comprising first physical coding sublayer (PCS) means that communicates with said translating means for decoding a fourth data stream to produce said first data stream.

86. The network device of claim 85 further comprising a first serializer/deserializer (SERDES) for outputting said fourth data stream to said PCS means.

87. The network device of claim 86 further comprising:

physical layer (PHY) means for generating a fifth data stream;

second data translating means for communicating with said PHY means and for converting said fifth data stream that is output by said PHY means to a sixth data stream at a higher data rate;

second PCS means for coding said sixth data stream into said fourth data stream; and

second SERDES means for serially communicating said fourth data stream to said first SERDES means.

88. The network device of claim 87 wherein said first PCS means performs 8/10 bit decoding and said second PCS means performs 8/10 bit encoding.

89. A method for operating a network device, comprising:

transmitting a first data stream at a first data rate that includes symbols having M bits; and

converting said first data stream to a second data stream at a second data rate by:

appending N bits to said symbols in said first data stream to generate second symbols having M+N bits; and

duplicating said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and $\left(1 + \frac{N}{M}\right) \cdot X$.

90. The method of claim 89 further comprising coding said second data stream received from said translating means to produce a third data stream at a third data rate.

91. The method of claim 90 further comprising receiving third data stream from said first PCS means and serially transmitting said third data stream.

92. The method of claim 89 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

93. The method of claim 89 wherein said first data rate is 10 Mb/s, N = 4, M=4, X=50 and said second data rate is 1000 Mb/s.

94. The method of claim 91 further comprising decoding said third data stream at said third data rate and for outputting said second data stream at said second data rate.

95. The method of claim 94 further comprising selecting one of X data symbols that are received, wherein said one of said X data symbols include (M+N) bits.

96. The method of claim 95 further comprising removing N of said (M+N) bits and outputting symbols with said M bits at said first data rate.

97. The method of claim 96 further comprising receiving said M bits at said first data rate.

98. The method of claim 97 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

99. The method of claim 97 wherein said first data rate is 10 Mb/s, N = 4, M=4, X=50 and said second data rate is 1000 Mb/s.

100. The method of claim 97 further comprising performing mode auto detection and switching between a first serial gigabit interface mode and a second serial gigabit interface mode.

101. The method of claim 94 further comprising performing 8/10 bit encoding and decoding.

102. A method for operating a network device, comprising:

transmitting a first data stream at a first data rate that includes symbols having M bits;

converting said first data stream to a second data stream at a second data rate by:

appending N bits to said symbols in said first data stream to generate second symbols having M+N bits; and

duplicating said second symbols X times to produce said second data stream at said second data rate, wherein said second data rate is equal to a product of said first data rate and $\left(1 + \frac{N}{M}\right)X$.

103. The method of claim 102 further comprising coding said second data stream received from said translating means to produce a third data stream at a third data rate.

104. The method of claim 103 further comprising receiving said third data stream from said first PCS means and serially transmitting said third data stream.

105. The method of claim 102 wherein said first data rate is 100 Mb/s, N = 4, M=4, X=5 and said second data rate is 1000 Mb/s.

106. The method of claim 102 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

107. The method of claim 104 further comprising:
transmitting said third data stream from a first SERDES to a second SERDES; and
decoding said third data stream at said third data rate and outputting said second data stream at said second data rate.

108. The method of claim 107 further comprising selecting one of X data symbols that are received from said second PCS, wherein said one of said X data symbols includes $(M+N)$ bits.

109. The method of claim 108 further comprising removing N of said $(M+N)$ bits and for outputting symbols with said M bits at said first data rate.

110. The method of claim 102 wherein said first data rate is 100 Mb/s, $N = 4$, $M=4$, $X=5$ and said second data rate is 1000 Mb/s.

111. The method of claim 102 wherein said first data rate is 10 Mb/s, $N = 4$, $M=4$, $X=50$ and said second data rate is 1000 Mb/s.

112. The method of claim 103 further comprising performing mode auto detection and switching between a first serial gigabit interface mode and a second serial gigabit interface mode.

113. The method of claim 107 further comprising performing at least one of 8/10 bit encoding and decoding.

114. A method for operating a network device in a first and second serial gigabit interface modes involving data speed translation, comprising:

receiving said idle order sets; and

switching from the first serial gigabit interface mode to the second serial gigabit interface mode if a first predetermined number of consecutive idle order sets are equal to a first idle order set.

115. The method of claim 114 further comprising disabling autonegotiation associated with the first serial gigabit interface mode when in the second serial gigabit interface mode.

116. The method of claim 114 further comprising sending said first idle order set after transitioning to the second serial gigabit interface mode.

117. The method of claim 114 further comprising receiving a second predetermined number of consecutive idle order sets that are equal to a second idle order set, said PHY means transitions to the first serial gigabit interface mode.

118. The method of claim 117 further comprising forcing a restart of autonegotiation in the first serial gigabit interface mode after transitioning to the first serial gigabit interface mode.

119. A method for operating a network device, comprising:

translating a first data stream at a first data rate to a third data stream at a third data rate by:

selecting one of X data symbols that are received, wherein said one of said X data symbols includes (M+N) bits, and outputting data at a second data stream at a second data rate; and

removing N of said (M+N) bits and outputting a third data stream including symbols with said M bits at a third data rate; and

receiving said third data stream at a physical layer device.

120. The method of claim 119 further comprising decoding a fourth data stream to produce said first data stream.

121. The method of claim 120 further comprising serially communicating said fourth data stream before said decoding step.

122. The method of claim 121 further comprising:

- generating a fifth data stream using a media access control (MAC) device;
- translating said fifth data stream to a sixth data stream at a higher data rate;
- coding said sixth data stream into said fourth data stream; and
- serially communicating said fourth data stream using a SERDES pair.

123. The method of claim 122 further comprising performing at least one of 8/10 bit encoding and decoding.

124. A method of operating a network device, comprising:

translating a first data stream at a first data rate to a third data stream at a third data rate by:

selecting one of X data symbols that are received, wherein said one of said X data symbols includes $(M+N)$ bits, and outputting data at a second data stream at a second data rate; and

removing N of said $(M+N)$ bits and outputting a third data stream including symbols with said M bits at a third data rate; and

receiving said third data stream at a media access control (MAC) device.

125. The method of claim 124 further comprising decoding a fourth data stream to produce said first data stream.

126. The method of claim 125 further comprising serially communicating said fourth data stream before said decoding step.

127. The method of claim 126 further comprising:

- generating a fifth data stream using a physical layer (PHY) device;
- translating said fifth data stream to a sixth data stream at a higher data rate;
- coding said sixth data stream into said fourth data stream; and
- serially communicating said fourth data stream using a SERDES pair.

128. The method of claim 127 further comprising performing at least one of 8/10 bit encoding and decoding.